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Maritimes Region
Canadian Science Advisory Secretariat
Science Advisory Report 2009/034

ASSESSMENT OF JONAH CRAB IN LOBSTER FISHING AREA 41 (4X + 5Zc)

Photograph: C. Day

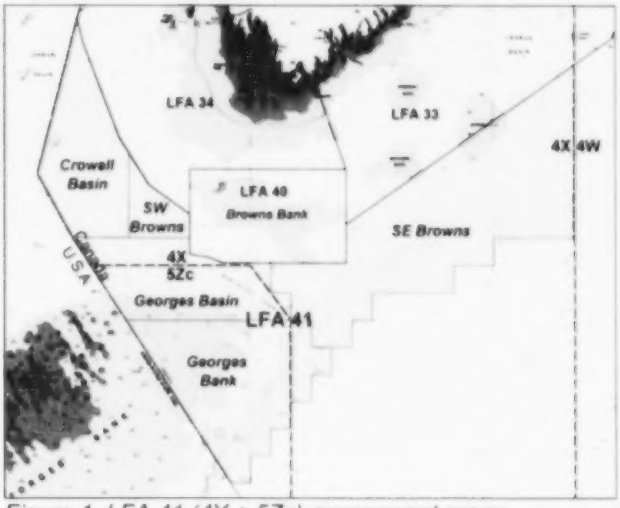

Figure 1. LFA 41 (4X + 5Zc) assessment areas.

Context :

The status of the Jonah crab (Cancer borealis) stocks in Lobster Fishing Area (LFA) 41 was last assessed in 2000. The Jonah crab fishery presently operates under the 2006-2010 Integrated Harvesting Plan with 8 licences and a total allowable catch (TAC) of 720t, and is authorized to fish in the 4X and 5Zc portions of LFA 41 (Figure 1). Since the 1960s, Jonah crab stocks have been exploited as a bycatch of the inshore and offshore lobster fisheries. Accurate landings are not available from these early fisheries. In the early 1980s, an experimental Jonah crab fishery concentrating in LaHave and Emerald Basins on the Scotian Shelf lasted only two years, before poor economic conditions resulted in the fishery closure.

The offshore Jonah crab fishery began in 1995. The species was fished as a bycatch in the lobster fishery and by vessels targeting the crab. The development of the LFA 41 Jonah crab fishery in 1995 resulted in more widespread fishing activity as vessels fished further east where crab concentrations were present. An experimental Jonah crab fishery took place in 4W between 1999 and 2002. Inshore Jonah crab fisheries also developed in LFA 33 and 34. After initial high landings the fishery has declined since 2000 with little or no activity in 2007 or 2008.

The Maritimes Region's Lobster Conservation Strategy (2004-2008) requires that, within each LFA, indicators be developed that are supported by a broad representation of stakeholders. Indicators for lobster in LFA 41 are required to remain consistent with the overall Lobster Conservation Strategy. As a bycatch in the LFA 41 lobster fishery, indicators for LFA 41 (4X + 5Zc) Jonah crab have been applied in a similar manner. The purpose of this Science Advisory Report is to evaluate the status of Jonah crab in LFA 41 (4X + 5Zc) in 2008 based on indicators for monitoring the health of the stock in this area.

June 2009

Canada

SUMMARY

- The Jonah crab fishery began in 1995, and the 720t TAC was caught or nearly caught between the 1996-1997 and 2000-2001 seasons. Landings then declined sharply with 14t landed in 2007. At present there is no directed fishery.
- The abundance indicators suggest that Jonah crab abundance in LFA 41 (4X + 5Zc) has declined since the fishery began in 1995.
- The cause of the decline in Jonah crab abundance cannot be given with certainty, but the decline detected in the areas fished suggests it is due to fishing down of the biomass present at the start of the fishery.
- There is insufficient information to evaluate production or recruitment trends for Jonah crab in LFA 41 (4X + 5Zc).
- The TAC of 720t set in 1995 (not science-based) does not appear to have been sustainable.
- Abundance indices from DFO Research Vessel bottom trawl surveys will be used to monitor the recovery of Jonah crab in LFA 41 (4X + 5Zc). Other information sources, including bycatch in the offshore lobster fishery and water temperature over the shelf, may also be used to monitor LFA 41 (4X + 5Zc) Jonah crab abundance in the future.

BACKGROUND

Species Biology

Jonah crab (*Cancer borealis*) can be found from Newfoundland to Florida, and in the Bermudas, at depths ranging from the intertidal to 800 m. Off Nova Scotia, they are found primarily at depths of 50-300 m and temperatures of 8-14 °C. The habitat occupied by Jonah crab changes along its geographical range from rocky substrates in Narragansett Bay and off the coast of Maine, to silt and clay off the continental slope. Inshore movement from spring through fall, followed in winter by emigration to deeper, warmer waters have been reported off Rhode Island. Size and sexual segregation with depth were reported in Norfolk Canyon, off the mouth of Chesapeake Bay, Virginia, where smaller-sized (<30 mm carapace width, CW) females were dominant at depths less than 150 m, and males were most abundant at depths over 150 m.

Very little biological information exists for Jonah crab in waters off Nova Scotia. Knowledge of life history is geographically limited to waters off New England and Chesapeake Bay. In Norfolk Canyon, males are mature at 90-100 mm CW and females are mature at 85 mm CW. Preliminary analysis of Jonah crab maturity on the Scotian Shelf has shown that morphometric (functional) maturity of 50 % of the males examined occurred at 128 mm CW. This size at maturity is much larger than the previous assumption of 110 mm CW. The estimated size of 50% maturity for females occurred at 92 mm CW.

Males can reach a maximum CW of approximately 180 mm with a weight of 0.9 kg. Females usually do not exceed 150 mm CW and 0.5 kg in weight. Ovigerous females as small as 65 mm CW have been reported on the Scotian Shelf. Ovigerous females have been found during August and September in Maine and in mid-July in Narragansett Bay. The spawning period in the Middle Atlantic Bight is suggested to be during late winter to early spring.

Fishery

The offshore lobster fishery (LFA 41), established in 1972, fishes from the 50 nautical mile line (92 km) out to the upper continental slope. While LFA 41 includes parts of the Northwest Atlantic Fisheries Organization (NAFO) Subareas 4Vs, 4W, 4X and 5Z, Jonah crab fishing is authorized only in 4X and 5Zc.

The offshore Jonah crab fishery began in 1995 when a 720t TAC (not science-based) was established for Jonah crab in LFA 41 (4X + 5Zc). The species is fished as a bycatch in the lobster fishery and by vessels targeting the crab. The development of the LFA 41 (4X + 5Zc) Jonah crab bycatch fishery in 1995 resulted in more widespread fishing activity as vessels fished further east where crab concentrations were present. An experimental Jonah crab fishery took place in 4W between 1999 and 2002.

Management Measures

There are 8 licenses to fish Jonah crab and lobsters in LFA 41; with a TAC of 720t for lobster and 720t for Jonah crab (status of lobster in LFA 41 is assessed in DFO 2009). The fishery is managed by input and output controls including a minimum size (CW), prohibition on landing females, limited entry, and a TAC (Table 1). An area encompassing all parts of Browns Bank <50 fathoms was closed to all lobster and Jonah crab fishing in 1979, though other fishing activity still occurs within it. This is referred to as the Browns Bank closed area or LFA 40 (Figure 1).

Table 1. Specifics of some current Jonah Crab management measures in LFA 41.

Season:	Year round Quota year Jan1-Dec 31
Minimum Legal Size:	130 mm CW
Landing of Females:	Prohibited
Trap Limit:	None
Number of Licences:	8
TAC:	720t

Landings and Effort

Historical landings by area (Crowell Basin, Southwest Browns, Georges Basin, Southeast Browns, and Georges Bank) are provided in Table 2 and Figure 2. The geographic distribution of landings in several time periods (1995/1996, 2000/2001 and 2007) are provided in Figure 3. The Gulf of Maine (GOM) area includes Crowell Basin, Southwest Browns and Georges Basin.

Table 2. LFA 41 Jonah crab landings by fishing areas 1995-2008, showing TAC for the quota period. Higher TAC in 2004-2005 was due to extended seasons during transition to a new quota period (change from Oct 15-Oct 14 to annual). The change in the quota year resulted in seven of the eight licences having an extended season during the transition in 2004-2005, and an annual TAC (Jan-Dec) during 2006 to 2007, while one licence continued under the Oct 16-Oct 15 TAC during those years. The remaining licence switched to an annual quota year in 2007. For simplicity in this report the landings and TAC are expressed on an annual basis for 2006 and 2007 to reflect the majority of the fishery.

	Crowell Basin	Southwest Browns	Georges Basin	Southeast Browns	Georges Bank	4W	Total	TAC
1995-96	8	18	0	74	196	5	300	720
1996-97	165	128	46	125	224		688	720
1997-98	301	67	101	148	81		697	720
1998-99	315	158	80	104	49		705	720
1999-00	241	88	19	233	114	69	765	720
2000-01	300	78	13	223	116	19	750	720
2001-02	157	90	8	233	107	19	614	720
2002-03	80	43	23	95	71		312	720
2003-04	56	15	5	74	21		171	720
2004-05	37	33	6	29	14		119	788
2006-06	0	2	1	21	0		25	720
2007-07	0	5	1	9	0		14	720
2008-08	0	0	0	3	0		3	720

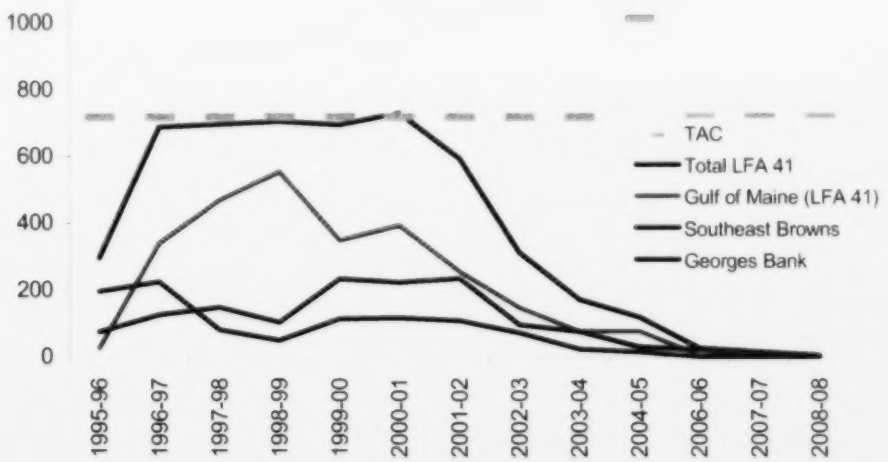

Figure 2. Landings of Jonah crab from the Gulf of Maine (GOM), Georges Bank, and Southeast Browns (SE Browns), and for all combined (Total), 1995-2008.

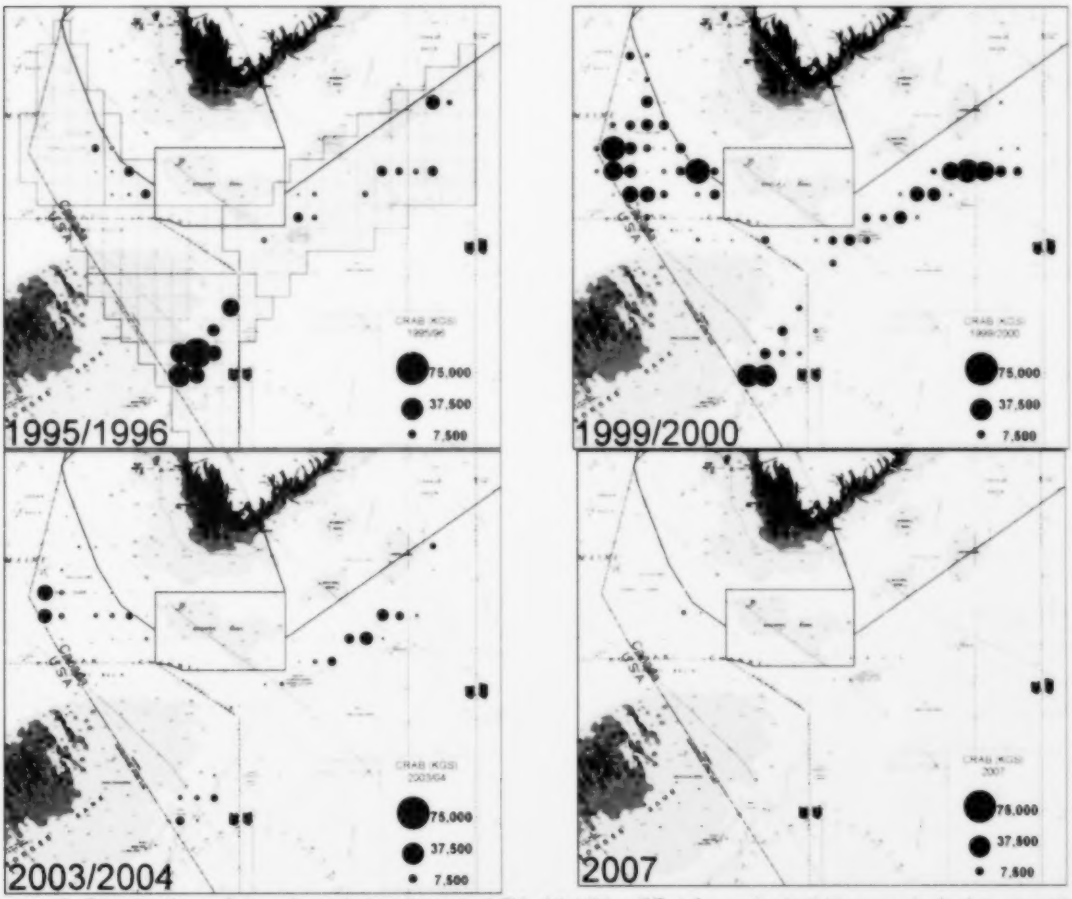

Figure 3. Distribution of Jonah crab landings in LFA 41 (4X + 5Zc) for selected time periods (aggregated by 10 min grids).

ASSESSMENT

Sources of Information

Data sources are as follows:

1. Lobster log books that provide daily records (1995-2000) and string by string records of catch, effort and location (2001-2008). The logbooks do not identify if the string of traps is targeting lobster or crab; therefore, any strings with crab landings reported are used in determining the number of trap hauls.
2. At-sea samples of the commercial catch (1999-2008).
3. DFO RV stratified random summer (1999-2008) bottom trawl survey.

Indicators for abundance (legal sizes), fishing pressure and production (pre-recruits and spawners) were developed from the above data sources. Indicators for abundance include landings, catch rate and RV survey mean number/tow. Indicators for fishing pressure are numbers of trap hauls, changes in size frequencies from independent at-sea samples of the commercial catch and the RV survey. Indicators for spawners are derived from these same sources.

In the absence of direct estimates of population abundance, this assessment has developed a number of indicators that can provide knowledge on trends in the stock and assist in determining appropriate management and harvest strategies.

Status and Trends

Abundance

Crab **landings** rose rapidly at the start of the fishery in 1995-1996, and the 720t TAC was caught or nearly caught between the 1996-1997 and 2000-2001 seasons (Figure 2). Landings then declined sharply with 14t landed in 2007. While overall landings were high, landings from individual areas rose and fell at different times (Figure 2). Initial landings for Georges Bank dropped in 1997-1998, while landings from areas in the Gulf of Maine increased, especially Crowell Basin in which landings remained high until 2000-2001 and then declined. Landings in Southeast (SE) Browns increased in 1999-2000 and were maintained until 2001-2002, when they began to decline to the current low levels.

Non-standardized catch rates from the commercial fishery (Catch Per Unit Effort, CPUE; landed kg/trap haul) for individual areas have followed a declining trend since the 2000-2001 fishing season (Figure 4).

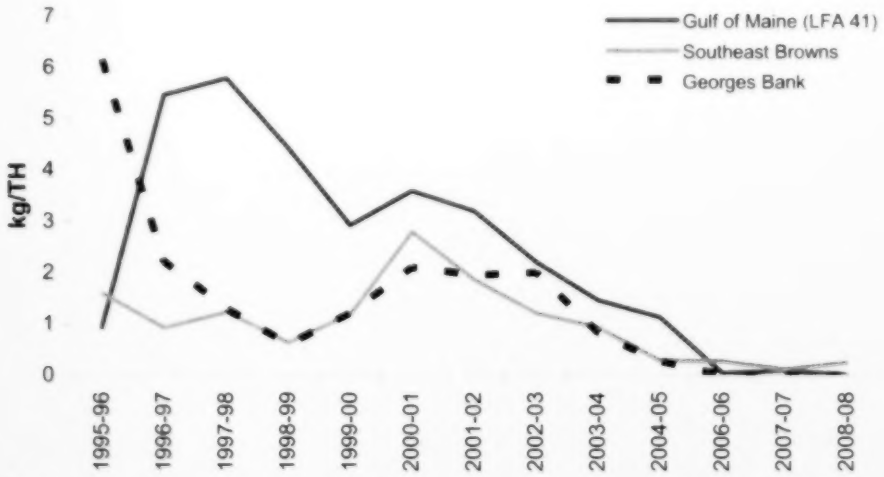

Figure 4. Catch rates (kg/trap haul) of Jonah crab from the Gulf of Maine (GOM), Georges Bank (G Bank), and Southeast Browns (SE BRNS) areas, 1995-2008.

A modeled CPUE index for Jonah crab was developed to adjust for the effects of fishing season, vessel and bi-weekly interval. A log-linear regression was fitted to each subset of area/period, with the additive main effects of fishing season, bi-weekly interval and vessel as factors. Model runs were made for each area/period group iteratively. The model found significant annual differences, with the most recent fishing seasons in each time series having consistently lower CPUE indices. Within season differences (bi-weekly) in CPUE indices were variable. Other factors potentially affecting Jonah crab CPUE (temperature, molt state, movement) were not evaluated and should be considered in future models.

Adjusted mean stratified number per tow in the DFO RV surveys show a general declining trend in all the strata surveyed in LFA 41, while areas outside of LFA 41 (LFA 33, LFA 34,

Western and Emerald Banks) show no downward trend (Figure 5). Issues of catchability, trawlable bottom and the variance around the mean values needs to be further evaluated.

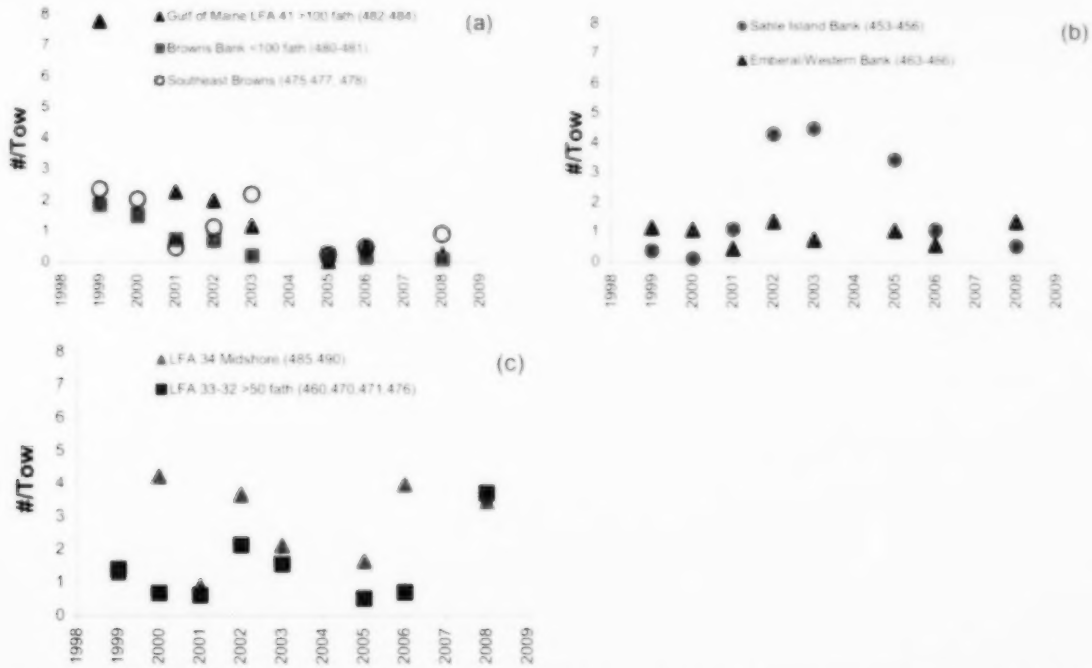

Figure 5. DFO Research Vessel summer bottom trawl survey adjusted stratified mean numbers of Jonah crab per tow for strata groups that fall within (a) LFA 41; (b) 4W; (c) Inshore areas.

Fishing Pressure

Trends in **trap hauls** over time in the Gulf of Maine, Georges Bank and SE Browns Bank portions of LFA 41, as well as trends in total trap hauls, are shown in Figure 6.

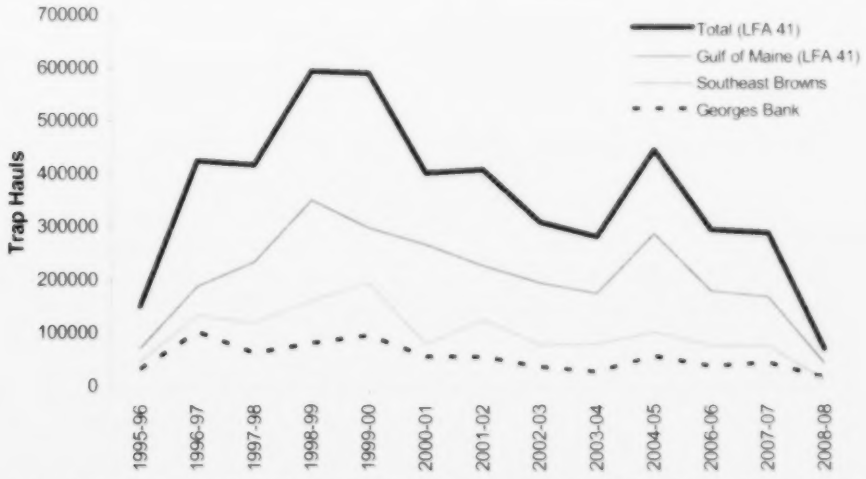

Figure 6. Trap hauls from the Gulf of Maine (GOM), Georges Bank (G Bank), and Southeast Browns (SE BRNS), and all areas combined (Total), 1995-2008. Higher effort in 2004-2005 was due to an extended season during transition to a new quota period (from Oct 15-Oct 14 to annual).

Size frequencies of male crab in Crowell Basin (1999, 2001, 2003, 2005) in spring show indications of a shift to smaller sizes in the most recent samples. Other areas show no change or no consistent trend in the proportion of the catch at size between 1999-2007.

Estimates of exploitation rates are not available.

Production

Pre-recruit and ovigerous Jonah crab are not well represented in the at-sea samples, and are present in low numbers in DFO RV bottom trawl surveys; therefore, there is insufficient information to evaluate production or recruitment trends for Jonah crab in LFA 41 (4X + 5Zc).

Ecosystem

Industry is not currently directing for Jonah crab in LFA 41 (4X + 5Zc). Jonah crab is caught primarily as bycatch within the lobster fishery, and ecosystem interactions are expected to be similar to those described for that fishery (DFO 2009).

Sources of Uncertainty

Growth rates, reproductive biology, stock structure and migration of Jonah crab are poorly understood. Information on the distribution of female Jonah crab is limited. The linkages between Jonah crab in LFA 41 and adjacent areas are uncertain, including sources of recruitment.

The logbooks do not identify if the string of traps is targeting lobster or crab; therefore, any strings with crab landings reported are used in determining the number of trap hauls. This may over estimate effort levels.

The waters of the outer shelf and basins in the Gulf of Maine are influenced by water mass movements caused by larger scale oceanographic events. Fishery-based indicators of abundance in LFA 41 may be influenced by these oceanographic events that could mask short-term changes in population size. Long-term trends in these indices may be more reliable.

Indicator Summary

A summary of indicators is provided below. Indicators were categorized as positive ("+") if values or trends were positive compared to the period of the last assessment (1995-99); negative ("--") if values or trends were negative in this same period; and neutral ("**o**") otherwise. Empty cells mean that no data is available or the indicator cannot be applied on that scale or time period.

	Data Source	Indicator	Overall	Georges Bank	SE Browns	SW Browns	Crowell Basin	Georges Basin
Abundance	Landings		--	--	--	--	--	--
	Trawl surveys	Mean # / tow Canada	--		--	--	--	--
	Catch Rate	Annual Catch rate	--	--	--	--	--	--
		Catch rate Model	--	--	--	--	--	--
Fishing Pressure	Effort	Trap Hauls	--					
	Size Distribution	Median size		o	o	o	--	

CONCLUSIONS AND ADVICE

The short time series for the Jonah crab fishery and the lack of information on some aspects of Jonah crab biology in LFA 41 (4X + 5Zc) limit the ability to assess the stock; however, both the fishery and the DFO RV survey indicate a decline in abundance following the introduction of the fishery.

The causes of the decline in Jonah crab abundance cannot be given with certainty, but the decline detected in the areas fished suggests it is due to fishing down of the biomass present at the start of the fishery. Future Jonah crab fisheries will have to rely on annual recruitment and growth. Females are not allowed to be retained regardless of size; therefore, the potential reproductive capacity of females is protected as long as there are sufficient males available and discards are low.

The migratory behaviour of the Jonah crab is not known and their catchability and ability to redistribute themselves over the fishing grounds is unclear. While lobsters are known to undertake seasonal migrations, it is not known whether Jonah crab off Nova Scotia undertake similar seasonal migrations.

The TAC of 720t set in 1995 (not science-based) does not appear to have been sustainable. The data suggest that low fishing pressure (relative to most fisheries) has contributed to a substantial reduction in the population. The apparent sensitivity of this stock to fishing pressure is cause for concern, and indicates any future fishery be limited by very low fishing effort. At present, industry is not directing for Jonah crab, and the abundance indices from the DFO RV bottom trawl surveys will be used to monitor the recovery of Jonah crab. Other information sources, including bycatch in the offshore lobster fishery and water temperature over the shelf, may also be used to monitor LFA 41 (4X + 5Zc) Jonah crab abundance in the future.

MANAGEMENT CONSIDERATIONS

Other Jonah crab fisheries in the inshore areas have also experienced recent declines in landings and fishing activity. A broad review of rock, red, and Jonah crab in the Maritimes Region may be helpful in providing a better understanding of population dynamics and contribute to improved guidelines for these fisheries.

SOURCES OF INFORMATION

DFO. 2009. Assessment of Lobster in Lobster Fishing Area 41 (4X + 5Zc). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2009/033.

Pezzack, D.S., C.M. Frail, A. Reeves, and M.J. Tremblay. 2009. Offshore Lobster in LFA 41 (4X + 5Zc). DFO Can. Sci. Advis. Sec. Res. Doc. 2009/023.

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